University of Southern Mississippi

Assessing the Potential of Photocatalytic Building Materials for Protecting Infrastructure and Developing Resiliency to Natural and Manmade Disasters

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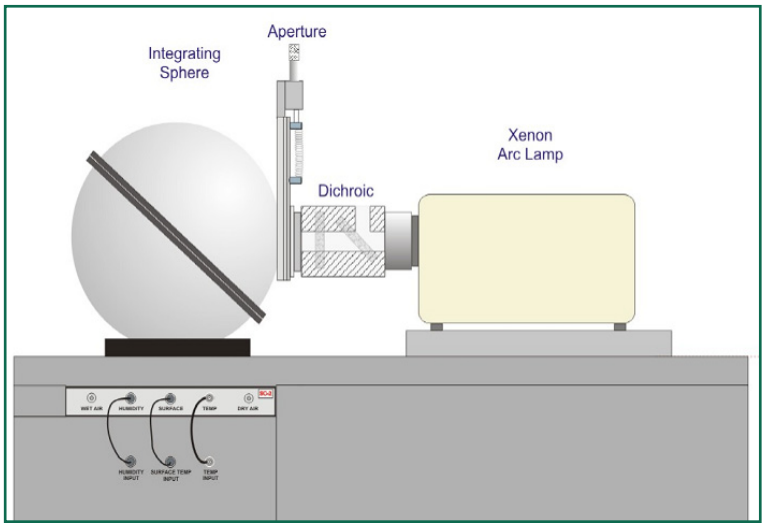
Prevent, Protect, Respond, Recover

Homeland Security Challenge:

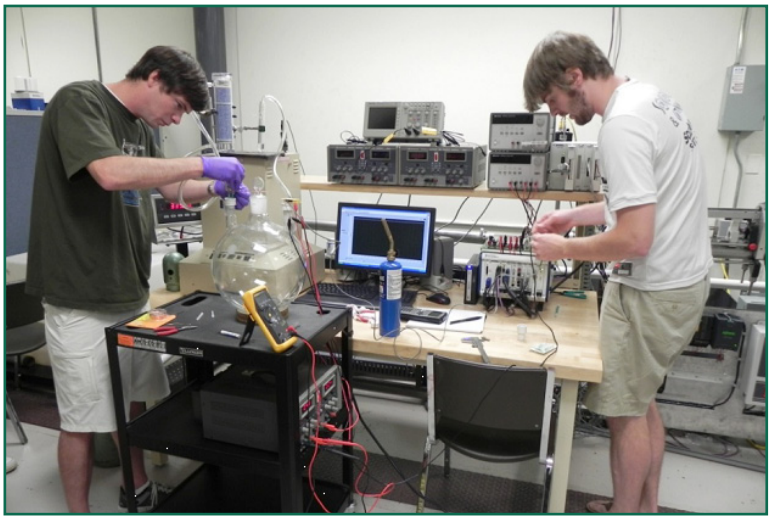
One of the nation's homeland security goals is to evaluate, characterize and develop technologies that can be used to decontaminate and manage hazardous chemical and biological materials that have been purposefully introduced into buildings and outdoor spaces as acts of terrorism. Another goal is to develop technologies that can be used to help mitigate environmental issues, such as mold that affect structures that have flooded. Although many titanium dioxide (TiO_2) photocatalytic materials and products are available, their effectiveness in addressing homeland security needs is largely unknown because of: (1) the lack of standardized testing techniques and the limited understanding of how these materials perform under a variety of environmental and illumination settings consistent with real world conditions; and (2) the lack of predictive tools to estimate their performance and the cost of using them.



Basic photoreactor design

Research Project Solution:

The objective of the initial phase of this research project is to design and build a new type of photoreactor that can be used to characterize the effectiveness of existing commercial TiO_2 photocatalytic materials to break down certain simulated biological and chemical agents. The experiments conducted with the new photoreactor will help establish a photocatalytic materials performance database. Subsequent phases of the project will utilize laboratory results contained in the performance database as well as information from other references to develop tools that can be used to predict the performance of photocatalytic materials in response to chemical and biological terrorisms as well as support the remediation and clean up after natural disasters.



Detection of photoxidation products is facilitated through a complex sensor array and supported by additional techniques such as GC/MS and FTIR

National Implications:

The nation could proactively improve its ability to protect critical infrastructure and speed its ability to respond to large-scale chemical and biological terrorism and natural events by furthering the development of existing self-decontaminating technologies. Because certain crystalline forms of TiO_2 have photocatalytic and/or superhydrophilic properties, these materials are currently being integrated into a select group of building structures to help maintain surface cleanliness. In recent years the photocatalytic anatase crystallographic form of TiO_2 has been used to create many self-cleaning structures, particularly in Europe, China and Japan. TiO_2 can accelerate the decomposition of many compounds and/or create highly washable surfaces.

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